

REMARKS

Applicants have canceled claim 14, without prejudice or disclaimer of its subject matter, and amended claims 13 and 18. Claims 13 and 15-20 are pending and under current examination.

Applicants' amendments to claims 13 and 18 are supported by the specification which states that "it is desirable to set the refractive index of SiON layer 5/7 to 1.50 or higher" and that "it is desirable to set the refractive index of SiON layers 5/7 to 1.55 or lower." (Page 16, line 22 to page 17, line 12) The method of manufacturing the SiON layers is described in page 11, lines 3-13. Further, in view of the desirability of maintaining the refractive index of the SiON layers 5/7 within the 1.50-1.55, as described in Applicants' specification at page 17, lines 13-23, and with reference to FIG. 7, it is clear that the refractive index of the SiON layers 5/7 is maintained substantially constant within the claimed range of refractive index.

Regarding the Office Action:

In the Office Action, the Examiner rejected claims 13, 16, and 17 under 35 U.S.C. § 102(e) and § 102(a) as anticipated by Smith, et al. (U.S. Patent No. 6,255,233) ("Smith"); rejected claims 14 and 15 under 35 U.S.C. § 103(a) as unpatentable over Smith taken with Noma et al. (U.S. Patent No. 6,437,424) ("Noma"); and rejected claims 18-20 under 35 U.S.C. § 103(a) as unpatentable over Smith taken with Kunikiyo (U.S. Patent No. 6,429,105) and Jang (U.S. Patent No. 6,235,633). Applicants traverse the rejections for the following reasons.

Rejection of Claims 13, 16, and 17 under 35 U.S.C. § 102(e) and § 102(a):

In order to properly establish that Smith anticipates Applicants' claimed invention under 35 U.S.C. § 102, each and every element of each of the claims in issue must be found, either expressly described or under principles of inherency, in that single reference. Furthermore,

“[t]he identical invention must be shown in as complete detail as is contained in the ... claim.”

See M.P.E.P. § 2131, quoting *Richardson v. Suzuki Motor Co.*, 868 F.2d 1126, 1236, 9

U.S.P.Q.2d 1913, 1920 (Fed. Cir. 1989).

Smith does not disclose each and every element of Applicants' claimed invention, despite the Examiner's allegations.

A semiconductor device manufacturing method in claim 13 comprises forming a first nitrogen-doped silicon oxide layer which has a substantially constant refractive index falling in a range between 1.50 (inclusive) and 1.55 (inclusive) throughout the first nitrogen-doped silicon oxide layer. Smith does not disclose this feature.

In Smith, “first graded silicon oxynitride” layer 160 and “second graded silicon oxynitride” layer 190 formed consecutively after SiN layers 150 and 180, respectively, are formed within the same chamber by combining the process gases for forming SiN and SiOF (Column 4, Line 57-61, Column 5, Line 35-39). Since the refractive index of a SiN layer that is applied as a Cu diffusion preventive layer is generally approximately 2.0, the refractive index of graded silicon oxynitride layers 160 and 190 in the vicinity of SiN layers 150 and 180, is approximately 2.0. SiO₂ (or SiOF) layers 170 and 200 are formed consecutively after graded silicon oxynitride layers 160 and 190 are formed (Column 4, Line 63-67, Column 5, Line 41-45). Since the refractive index of a SiO₂ (or SiOF) layer applied as an interlayer insulating layer is generally around 1.42 to 1.48, the refractive index of graded silicon oxynitride layers 160 and 190 in the vicinity of SiO₂ (or SiOF) layers 170 and 200 is around 1.42 to 1.48. As a result, it appears that the refractive index of each of graded silicon oxynitride layers 160 and 190 has a graded profile in the depth direction ranging from 2.0 to 1.45. This is entirely consistent with each of layers 160 and 190 being described in Smith as “graded”. On the other hand, as

previously explained, claim 13 requires a nitrogen-doped silicon oxide layer having a refractive index range of 1.50 to 1.55 throughout the nitrogen-doped silicon oxide layer. Furthermore, the refractive index of the nitrogen-doped silicon oxide layer in claim 13 is substantially constant, while graded silicon oxynitride layers 160 and 190 in Smith appear to have a graded profile.

In addition, Smith also implies that the refractive index of SiON layers 160 and 190 in the vicinity of SiOF layer 170 and 200 is around 1.45 because Smith describes that “[s]econd dielectric layer 125 may be a fluorinated silicon oxide, so that the dielectric constant of the film is lower than that of pure silicon dioxide.” (Column 4, Lines 28-30) Since the refractive index of the SiOF layer lowers in proportion to the permittivity, the refractive index of the SiOF layer is likely around 1.45, which means that the refractive index of the SiON layers in the vicinity of SiOF layers 170 and 200 is also around 1.45. Therefore, Smith does not disclose each and every element of Applicants’ claimed invention.

Regarding the Rejection of Claims 14 and 15 under 35 U.S.C. § 103(a):

Applicants respectfully traverse the rejection of claims 14 and 15 under 35 U.S.C. § 103(a) as unpatentable over Smith taken with Noma. Applicants disagree with the Examiner’s arguments and conclusions. A *prima facie* case of obviousness has not been established.

“To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on

applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)." M.P.E.P. § 2142, 8th Ed., Rev. 2 (May 2004), p. 2100-128.

A *prima facie* case of obviousness has not been established because there is no suggestion or motivation to combine Smith with Noma. Noma discloses a barrier film 20 which is formed of, e.g., a SiON to prevent moisture or H atoms from being diffused into the memory cell portion. The moisture or H atoms diffuses from a plasma TEOS film and a SOG film (mainly moisture in the SOG film) (Column 5, Lines 34-57). In contrast, Smith discloses a graded silicon oxynitride layer to decrease stress between layers. Since there is no suggestion or motivation in Smith to block moisture or H atoms output from a TEOS film or a SOG film, there is no suggestion or motivation to adjust the refractive index of the graded silicon oxynitride layer suitable for trapping moisture or H atoms.

Further, there is no reasonable expectation of success. Smith discloses forming a graded silicon oxynitride layer within the same chamber by combining the process gases for forming SiN and SiOF. If the refractive index of the graded silicon oxynitride layer is adjusted to be suitable for trapping moisture or H atoms, there is a difference of refractive indexes both between the interfaces of SiN and SiON, and between the interfaces of SiON and SiOF. However it is difficult to change refractive index rapidly within the same chamber by combining the process gases for forming SiN and SiOF. It is also difficult to form SiON with SiN and SiOF when the refractive index changes rapidly at the interfaces. Therefore, there is no reasonable expectation of success.

Since the Examiner has not established a *prima facie* case of obviousness, Applicants request that the Examiner withdraw the rejection of claims 14 and 15 as unpatentable over Smith and Noma.

Rejection of Claims 18-20 under 35 U.S.C. § 103(a):

Applicants respectfully traverse the rejection of claims 18-20 under 35 U.S.C. § 103(a) as unpatentable over Smith taken with Kunikiyo and Jang. Applicants disagree with the Examiner's arguments and conclusions. A *prima facie* case of obviousness has not been established because, among other things, neither Kunikiyo nor Jang teach or suggest forming a first nitrogen-doped silicon oxide layer which has a substantially constant refractive index falling in a range between 1.50 (inclusive) and 1.55 (inclusive) throughout said first nitrogen-doped silicon oxide layer, which is an element of Applicants' claims.

Applicants therefore request that the Examiner withdraw the rejection of claims 18-20 as unpatentable over Smith, Kunikiyo, and Jang.

Conclusion:

In view of the foregoing amendments and remarks, Applicants request reconsideration of the application and withdrawal of the rejections. Pending claims 13 and 15-20 are in condition for allowance, and Applicants request a favorable action.

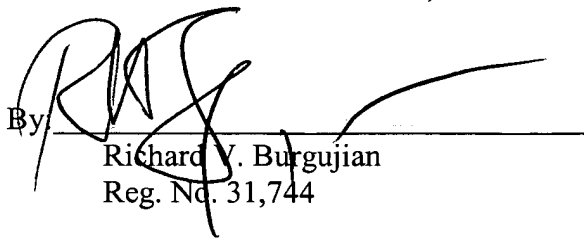
Please grant any extensions of time required to enter this response and charge any additional required fees to our deposit account 06-0916.

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, L.L.P.

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By


Richard V. Burgujian
Reg. No. 31,744

/direct telephone: (571) 203-2790/